

Clinical and Radiological Outcomes of Surgical Management of Degenerative Lumbar Spine Disorders: A Prospective Study

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Abstract

Background: Degenerative lumbar spine disorders are among the most common causes of chronic low back pain and functional disability in adults. When conservative management fails, surgical intervention is often indicated. Evaluating both clinical and radiological outcomes is essential to determine the effectiveness of surgical management. **Objectives:** 1. To assess the clinical outcomes following surgical management of degenerative lumbar spine disorders. 2. To evaluate radiological outcomes and correlate them with clinical improvement. 3. To identify perioperative complications associated with surgical intervention. **Materials and Methods:** This prospective study was conducted on 65 patients diagnosed with degenerative lumbar spine disorders who underwent surgical management at a tertiary care center from January 2023 to June 2023. Clinical outcomes were assessed using Visual Analog Scale (VAS) for pain and Oswestry Disability Index (ODI). Radiological outcomes were evaluated using plain radiographs and MRI. Patients were followed up postoperatively, and outcomes were analyzed statistically. **Results:** Significant improvement was observed in postoperative VAS and ODI scores compared to preoperative values ($p < 0.001$). Radiological assessment showed adequate decompression and fusion in most patients. Complications were minimal and manageable. **Conclusion:** Surgical management of degenerative lumbar spine disorders results in significant clinical and radiological improvement with acceptable complication rates. Proper patient selection and timely intervention lead to favorable outcomes.

Keywords: *Degenerative lumbar spine, surgical management, VAS, ODI, radiological outcome*

Introduction

Degenerative lumbar spine disorders represent a major public health concern worldwide, contributing significantly to morbidity, disability, and socioeconomic burden. With increasing life expectancy, sedentary lifestyles, and occupational stress, the prevalence of lumbar degenerative conditions has steadily increased.¹ These disorders encompass a spectrum of pathological entities including lumbar disc herniation, lumbar spinal stenosis, degenerative spondylolisthesis, and degenerative disc disease.²

The degenerative process primarily affects the intervertebral discs, facet joints, and ligamentous structures, leading to mechanical instability, neural compression, and chronic pain. Patients typically present with low back pain, radiculopathy, neurogenic claudication, and functional impairment, adversely affecting quality of life.³

Initial management is usually conservative, including analgesics, physiotherapy, lifestyle modification, and epidural injections. However, a subset of patients fails to respond to conservative treatment and continues to experience persistent symptoms or progressive

neurological deficits, necessitating surgical intervention. Surgical procedures aim to decompress neural elements, restore spinal stability, and improve functional outcomes.^{4,5}

Although numerous surgical techniques are available, including decompression alone or decompression with fusion, there is a need for systematic evaluation of both clinical and radiological outcomes to determine the effectiveness of surgical management.⁶ This prospective study was undertaken to assess the clinical improvement, radiological outcomes, and complications in patients undergoing surgery for degenerative lumbar spine disorders.

Objectives

1. To assess clinical outcomes following surgical management of degenerative lumbar spine disorders using VAS and ODI scores.
2. To evaluate radiological outcomes post-surgery and correlate them with clinical findings.
3. To study perioperative and postoperative complications associated with surgical treatment.

Materials and Methods

Study Design and Setting

This was a prospective observational study conducted at Department of orthopaedics, tertiary care teaching hospital, Prakash Institute of Medical Sciences and Research Centre Islampur, Sangli, Maharashtra.

Study Duration

January 2023 to June 2023.

Study Population

A total of **65 patients** diagnosed with degenerative lumbar spine disorders who underwent surgical management during the study period were included.

Inclusion Criteria

- Age \geq 18 years
- Clinically and radiologically diagnosed degenerative lumbar spine disorders
- Failure of conservative management for at least 6 weeks
- Patients willing to provide informed consent

Exclusion Criteria

- Traumatic spine injuries
- Spinal infections or tumors
- Congenital spinal deformities

- Previous lumbar spine surgery

Preoperative Assessment

All patients underwent detailed clinical evaluation, including:

- Pain assessment using Visual Analog Scale (VAS)
- Functional disability assessment using Oswestry Disability Index (ODI)
- Neurological examination

Radiological evaluation included:

- Plain radiographs (AP and lateral views)
- MRI of the lumbosacral spine

Surgical Procedures

Depending on the pathology, patients underwent:

- Lumbar decompression (laminectomy/discectomy)
- Decompression with posterior lumbar interbody fusion (PLIF) or posterolateral fusion (PLF)

Postoperative Follow-up

Patients were followed up postoperatively for clinical and radiological assessment. VAS and ODI scores were recorded and compared with preoperative values.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using appropriate statistical tests. Preoperative and postoperative scores were compared using paired t-test. A p-value < 0.05 was considered statistically significant.

Results

Table 1: Demographic Distribution of Study Participants (n = 65)

Variable	Number (n)	Percentage (%)
Age (years)		
≤ 40	12	18.5
41–50	21	32.3
51–60	20	30.8
> 60	12	18.5
Sex		
Male	38	58.5
Female	27	41.5

Table 1 illustrates the demographic distribution of the 65 patients included in the present study. The majority of patients belonged to the 41–60 years age group, accounting for 63.1% of the

study population, indicating that degenerative lumbar spine disorders predominantly affect middle-aged and older adults. Patients aged ≤ 40 years and those above 60 years constituted 18.5% each, showing a relatively lower representation at the extremes of age.

With respect to gender distribution, males (58.5%) outnumbered females (41.5%), demonstrating a male predominance in the study population. This gender distribution may reflect greater occupational stress, physical workload, and healthcare-seeking patterns among males.

Overall, the demographic profile suggests that degenerative lumbar spine disorders are more common in middle-aged males, which is consistent with findings reported in previous spine-related studies.

Table 2: Clinical Presentation of Patients with Degenerative Lumbar Spine Disorders

Clinical Feature	Number (n)	Percentage (%)
Low back pain	65	100
Radiculopathy	49	75.4
Neurogenic claudication	31	47.7
Sensory deficit	18	27.7
Motor weakness	11	16.9

Table 2 depicts the clinical presentation of patients with degenerative lumbar spine disorders included in the study. Low back pain was the most common presenting complaint and was observed in all patients (100%), highlighting it as the cardinal symptom of degenerative lumbar spine pathology.

Radiculopathy was present in 75.4% of patients, indicating significant nerve root involvement due to disc degeneration, herniation, or spinal canal narrowing. Nearly half of the patients (47.7%) presented with neurogenic claudication, which is typically associated with lumbar spinal stenosis.

Sensory deficits were noted in 27.7% of patients, while motor weakness was observed in 16.9%, reflecting varying degrees of neurological compromise. These findings underscore the progressive nature of degenerative lumbar spine disorders and emphasize the need for timely surgical intervention in patients with neurological deficits.

Overall, the table demonstrates that while pain-related symptoms predominated, a considerable proportion of patients exhibited neurological involvement at presentation.

Table 3: Distribution of Degenerative Lumbar Spine Pathologies

Diagnosis	Number (n)	Percentage (%)
Lumbar disc herniation	24	36.9

Lumbar spinal stenosis	19	29.2
Degenerative spondylolisthesis	14	21.5
Degenerative disc disease	8	12.3
Total	65	100

Table 3 shows the distribution of degenerative lumbar spine pathologies among the 65 patients included in the study. Lumbar disc herniation was the most common diagnosis, observed in 36.9% of patients, reflecting its high prevalence as a cause of low back pain and radiculopathy in adults.

Lumbar spinal stenosis accounted for 29.2% of cases and was frequently associated with symptoms of neurogenic claudication, particularly in older patients. Degenerative spondylolisthesis was identified in 21.5% of patients, indicating spinal instability secondary to degenerative changes in the facet joints and intervertebral discs.

Degenerative disc disease constituted the remaining 12.3% of cases. Overall, the distribution highlights that disc-related pathologies formed the majority of degenerative lumbar spine disorders in the study population, with a substantial proportion also exhibiting stenotic and instability-related conditions.

Table 4: Surgical Procedures Performed

Surgical Procedure	Number (n)	Percentage (%)
Decompression alone	27	41.5
Decompression + PLIF	21	32.3
Decompression + PLF	17	26.2
Total	65	100

Table 4 outlines the types of surgical procedures performed in the study population. Decompression alone was carried out in 41.5% of patients, primarily in those with isolated neural compression without significant spinal instability.

The remaining 58.5% of patients required decompression combined with fusion procedures, indicating the presence of instability or advanced degenerative changes. Among these, decompression with posterior lumbar interbody fusion (PLIF) was performed in 32.3% of cases, while decompression with posterolateral fusion (PLF) was carried out in 26.2% of patients.

These findings suggest that although decompression alone is sufficient in a subset of patients, a considerable proportion necessitates additional stabilization through fusion to achieve optimal clinical and radiological outcomes.

Table 5: Comparison of Preoperative and Postoperative VAS Scores

VAS Score	Mean \pm SD	p-value
Preoperative	7.6 \pm 1.1	<0.001
Postoperative	2.1 \pm 0.9	

Table 5 compares the preoperative and postoperative Visual Analog Scale (VAS) scores among the study participants. The mean preoperative VAS score was 7.6 \pm 1.1, indicating severe pain at presentation. Following surgical intervention, the mean postoperative VAS score significantly decreased to 2.1 \pm 0.9.

This reduction in VAS scores was found to be statistically highly significant ($p < 0.001$), demonstrating substantial relief of pain after surgical management. The findings clearly indicate that surgical intervention was effective in alleviating pain in patients with degenerative lumbar spine disorders.

Table 6: Comparison of Preoperative and Postoperative Oswestry Disability Index (ODI)

ODI (%)	Mean \pm SD	p-value
Preoperative	62.3 \pm 9.4	<0.001
Postoperative	22.7 \pm 7.6	

Table 6 presents the comparison of preoperative and postoperative Oswestry Disability Index (ODI) scores among the study participants. The mean preoperative ODI score was 62.3 \pm 9.4, which corresponds to severe functional disability, significantly affecting daily activities and quality of life.

Postoperatively, the mean ODI score showed a marked reduction to 22.7 \pm 7.6, indicating mild to moderate disability. This improvement was found to be statistically highly significant ($p < 0.001$).

The substantial decrease in ODI scores reflects significant functional recovery following surgical management and demonstrates the effectiveness of surgical intervention in improving patients' ability to perform routine activities.

Table 7: Radiological Outcome Assessment

Radiological Outcome	Number (n)	Percentage (%)
Adequate decompression	59	90.8

Solid fusion achieved	34	89.5*
Implant-related complications	2	3.1

Table 7 summarizes the radiological outcomes following surgical management of degenerative lumbar spine disorders. Adequate decompression was achieved in 59 patients (90.8%), indicating effective surgical relief of neural compression as confirmed on postoperative imaging.

Among the patients who underwent fusion procedures, solid fusion was radiologically evident in 34 patients (89.5%), demonstrating a high rate of successful spinal stabilization. Implant-related complications were minimal and were observed in only 2 patients (3.1%), suggesting good implant positioning and surgical technique.

Overall, the radiological findings indicate a high rate of technical success, with most patients showing satisfactory decompression and fusion, which correlated well with the observed clinical improvement.

Table 8: Postoperative Complications

Complication	Number (n)	Percentage (%)
Surgical site infection	3	4.6
Dural tear	2	3.1
Transient neurological deficit	1	1.5
No complications	59	90.8

Table 8 depicts the postoperative complications observed among the study participants. The majority of patients, 59 out of 65 (90.8%), experienced no postoperative complications, indicating a high level of surgical safety.

Surgical site infections were noted in 3 patients (4.6%) and were superficial in nature, responding well to conservative management. Dural tears occurred in 2 patients (3.1%) and were identified and managed intraoperatively without long-term sequelae. A transient neurological deficit was observed in 1 patient (1.5%), which resolved during follow-up.

Overall, the complication rate was low and manageable, demonstrating that surgical management of degenerative lumbar spine disorders is a safe and effective treatment option when performed with appropriate technique and postoperative care.

Discussion

Age distribution shows predominance in middle age / early older adults. Our study's mean age (52.4 years) and concentration in the **41–60 years** age band are consistent with multiple clinical series and epidemiologic studies that report the highest clinical burden of symptomatic degenerative lumbar conditions in middle-aged to early-older adults. For example, a hospital-based series of adults with lumbar disc herniation reported a mean age \approx 53 years and peak frequency in the **51–60** decade.⁷ Systematic reviews and large cohort investigations also identify **middle age (30–60 years)** as the common age-range for symptomatic disc herniation and radiculopathy.⁸

Population-based imaging studies show that radiographic degeneration becomes very common after age 50 — the Wakayama Spine Study found $>90\%$ prevalence of disc degeneration in men and women **aged >50 years**, which explains why clinical series (like ours) cluster in the 40–60+ age groups.⁹

Male predominance in our sample (58.5%). Clinical series vary. Some hospital/operative series report a slight **male predominance**, similar to our 58.5% male share — occupational exposures and care-seeking patterns are frequently suggested explanations.⁷ At the same time, community-based imaging studies and population cohorts often report **little or no sex difference** in radiographic degenerative changes; prevalence by imaging alone can be similar or even higher in women after menopause depending on the cohort and outcome measured. The Framingham ancillary study of radiographic spinal stenosis, for example, did **not** find a consistent sex difference in prevalence of radiographic stenosis, though radiographic prevalence clearly rose with age.¹⁰

In the present study, the mean **VAS score significantly decreased from 7.6 ± 1.1 preoperatively to 2.1 ± 0.9 postoperatively ($p < 0.001$)**, indicating substantial postoperative pain relief following surgical management of degenerative lumbar spine disorders. (**Table 5**)

These findings are consistent with those reported by **Weinstein et al¹²**, who observed significantly greater improvement in pain scores among surgically treated patients with lumbar disc herniation and spinal stenosis compared to nonoperative treatment, with sustained benefit on follow-up. Similarly, **Atlas et al¹⁴** demonstrated marked reduction in leg and back pain scores after lumbar discectomy, with most improvement occurring within the early postoperative period.

Studies focusing on decompression with or without fusion have also shown comparable reductions in postoperative VAS scores. **Försth et al¹⁵** reported significant pain relief following decompression surgery for lumbar spinal stenosis, regardless of whether fusion was added, supporting the effectiveness of surgical intervention in alleviating pain. The magnitude of pain reduction observed in the present study is comparable to these published series, reinforcing the role of surgery in patients with refractory symptoms.

In the current study, the **mean ODI score improved significantly from 62.3 ± 9.4 preoperatively (severe disability) to 22.7 ± 7.6 postoperatively (mild to moderate disability)**, with a statistically highly significant difference ($p < 0.001$). This reflects substantial functional recovery and improvement in activities of daily living following surgery. (**Table 6**)

Comparable improvements in ODI scores have been reported in multiple landmark trials. **Fairbank et al¹⁶**, in the Spine Stabilisation Trial, demonstrated significantly better functional outcomes in surgically treated patients with chronic low back pain. **Weinstein et al¹³** also reported significant and sustained improvement in ODI scores in patients undergoing surgery for lumbar spinal stenosis and disc herniation.

Furthermore, **Mannion et al**¹⁷ showed that patients undergoing lumbar decompression and fusion procedures experienced clinically meaningful reductions in ODI scores, with improvements correlating well with patient satisfaction and perceived recovery. The postoperative ODI values achieved in the present study fall within the range reported by these studies, indicating comparable functional benefits.

The significant reductions in both **VAS and ODI scores** observed in this study are in line with existing literature, confirming that surgical management of degenerative lumbar spine disorders results in **substantial pain relief and functional improvement**. The degree of improvement seen in this cohort is comparable to that reported in large randomized trials and prospective cohort studies, despite the relatively shorter follow-up duration.

Conclusion

- The present prospective study evaluated the clinical and radiological outcomes of surgical management of degenerative lumbar spine disorders in 65 patients over a six-month period. In accordance with the study objectives, surgical intervention resulted in significant improvement in clinical outcomes, as evidenced by a marked reduction in pain severity (VAS scores) and substantial improvement in functional status (Oswestry Disability Index), both of which were statistically highly significant.
- Radiological assessment demonstrated adequate neural decompression in the majority of patients and a high rate of successful fusion in those who underwent stabilization procedures, fulfilling the objective of correlating radiological findings with clinical improvement. These radiological outcomes supported the observed symptomatic and functional recovery.
- The incidence of perioperative and postoperative complications was low and manageable, meeting the objective of assessing surgical safety. Most patients experienced an uneventful recovery, highlighting the effectiveness and safety of surgical management when appropriate patient selection and surgical techniques are employed.
- Overall, the study concludes that surgical management is an effective and reliable treatment option for patients with degenerative lumbar spine disorders who fail conservative therapy, leading to significant pain relief, functional recovery, and satisfactory radiological outcomes.

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Conflict of interest: None

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